CLAIMS

[1] A piezo-electric ceramic transducer which bends in a thickness direction thereof by applying voltage to the transducer, the transducer comprises:

two piezo-electric active layers having at least one piezo-electric layer respectively, said piezo-electronic active layers being applied coltages via electrode layers so that one of said piezo-electric active layer expands and the other one contracts,

two insulating layers, between which said two piezo-electric active layers are placed, disposed on both surfaces of said piezo-electric ceramic transducer in a thickness direction thereof,

electrode pads disposed on only one of said two insulating layers and electrically connected with said electrode layers, and

wherein said piezo-electric active layers and said insulating layers are made of the same material as one another and are integrated with one another by sintering.

[2] The piezo-electric ceramic transducer according to claim 1, wherein said piezo-electric active layers have a plurality of piezo-electric layers separated from one another by said electrode layers.

[3] The piezo-electric ceramic transducer according to claim 1, further comprising an intermediate insulating layer disposed between said two piezo-electric active layers.

[4] The piezo-electric ceramic transducer according to claim 3,

wherein polarization directions of said two piezo-electric active layers are same in polarization directions of said piezo-electronic layers which are most adjacent to each other in relation between one of said piezo-electric active layer and the other of said piezo-electric active layer.

[5] The piezo-electric ceramic transducer according to claim 4, wherein two electrode layers adjacent to each other through said intermediate insulating layer among said electrode layers are electrically short-circuited, and said piezo-electric active layers being electrically connected with each other in parallel.

[6] The piezo-electric ceramic transducer according to claim 3, wherein the electrode pad comprises:

two first pad portions for polarization electrically connected with said electrode layer of one of said piezo-electric active layers, and two second pad portions for polarization electrically connected with said electrode layer of the other piezo-electric active layer, said first and second pad portions being used in a polarization process for said piezo-electric layers; and

a coupling portion for coupling the first pad portions with the second pad portions.

[7] The piezo-electric ceramic transducer according to claim 1, further comprising an elastic body joined to at least one of said two insulating layers.

[8] The piezo-electric ceramic transducer according to claim 7, wherein said elastic body is joined to one of said insulating layer, on which said electrode pads are not disposed, among said insulating layers.

[9] The piezo-electric ceramic transducer according to claim 1, wherein a stationary part is attached to the transducer, and an elastic body is joined to said stationary part to cause a displacement of the stationary part so as to become smaller than a displacement of the piezo-electric ceramic transducer at an end of said piezo-electric ceramic transducer.

[10] The piezo-electric ceramic transducer according to claim 9, wherein said stationary part is attached to a position different from a position of a center of said piezo-electric ceramic transducer.

[11] The piezo-electric ceramic transducer according to claim 9, wherein said elastic body is a box, and said piezo-electric ceramic transducer is attached to an inside portion of said box.

[12] A portable device comprising:

a piezo-electric ceramic transducer claimed in claim 1, and

a part, joined to said piezo-electric ceramic transducer, to which displacement of said piezo-electric ceramic transducer is transmitted.

[13] A portable device comprising:

a piezo-electric ceramic transducer claimed in claim 1,

a stationary part attached to said piezo-electric ceramic transducer,

an elastic body, joined to said stationary part, which makes a displacement of said stationary part to become smaller than a displacement of said piezo-electric ceramic transducer at an end of said piezo-electric ceramic transducer, and

wherein an acoustical radiation is generated form said elastic body.

[14] The portable device according to claim 13, wherein said elastic body is a case body of the portable device.

[15] The portable device according to claim 13, wherein said stationary part is attached to a position different from a position of a center of said piezo-electric ceramic transducer.